Phantom Limb, Phantom Pain and Stump Pain (Part I)

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Phantom Limb, Phantom Pain and Stump Pain (Part I)

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ABSTRACT : We classified phantom limbs into five types, which vary according to the circumstance and psychological condition of the amputee. Phantom limbs can enlarge or elongate. The types of phantom limbs of amputees are basically the same but the disregarded phantom limbs are to be suppressed. An amputee who has Type I or II can describe conditions of the phantom limb with respect to the normal limb, can move the phantom limb voluntarily and can utilize it as the feedback mechanism when the prosthesis fits perfectry. Type II ampatee feels that the phantom limb can fit in a phosthesis and Type III amputee has strong psychological conflict between needs and suppression. Malfitting, malalignement of the prosthesis and abnormal gait pattern of the lower extremity amputee can be corrected to some extent. Lower extremity phantom limb is related to the gait pattern and upper extremity phantom limbs is related to hand function.

INTRODUCTION

It is not uncommon amputees (including the disarticulated amputees) to have a feeling as if they still have extremities existing, and it greatly affects the amputees and their daily life. Phantom limb of the amputees is comsidered to be the projection of the body image with the sensory aspect as phantom pain. The amputee can recognize the phantom limb (as he has, for some part, clear picture; for others, vague picture of the phantom limb), and it can be drawn by the method of projections; which delineates the difference from the hallucination of the psychiatric patients. The image of the phantom limb is generally monochrome with some exceptions. But with the prevalence of color TV sets, more people tend to have colored dream and they may have the colored image when they are amputated. People do not have complaint of pain in the normal state, thus the amputee who has phantom pain is regarded to be in the abnormal state. In this case, factors behind the complaint should be detected and analyzed to solve each problem.

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I Phantom Limb

1. Drawing Projections of the Phantom Limb (Otsuka)

a. Lower Extremity Amputee

1) Place the unaffected lower extrimity extended in prone position on a sheet of paper. Contour with a felt-tipped marker and mark the positions of hip joint, knee joint, foot joint and phalangeal joints; thus the projection of the frontal plane can be drawn. 2) Draw the sagittal projection as

well in side-lying position and mark the joints. 3) Draw the horizontal projection of the foot and mark the joints. 4) Turn over the sheet of paper and trace the lines to draw projections of the amputated lower extremity (on the premise that both extremities are symmetrical. 5) Write down the scales. 6) Place the stump exactly on the projection and contour it. 7) Draw the image of the phantom limb on it (may have the amputee draw it by himself). 8) Compare the projection with prosthesis to find out the relationship. 9) When the amputee complains the phantom pain or stump pain, write down the complaints, onsettime, treatment for the pain, etc., on each place. At the same time note the condition of the stump (i. e., scar, adhesion, neuroma, etc.) and anxieties for living (financial anxiety, pcychological anxiety or physical anxiety). Follow the same procedure for upper extremity amputees.

b. Upper Extremity Amputee

1) Place the unaffected upper extremity extended in pronated position on a sheet of paper. Contour with a felt-tipped marker and mark the positions of shoulder joint, elbow joint, wrist joint and phalangeal joints; thus the projection of the frontal plane can be drawn. 2) Draw the sagittal projection as well in neutral position, and add extended as well as flexed position of each phalanx. 3) Turn over the sheet of paper and trace the lines to draw projections of the amputated upper extremity. 4) Write down the scales.

2. Types of Phantom Limbs (Otsuka), Utility and Reversibility of Types

The author has classifield the types and utility of phantom limbs, he thinks the phantom limb originates from central mechanism and modified by peripheral factors. Adult amputee normally has a phantom limb immediately after amputation (however, phantom limb with pain is considered as an abnormal state). Psychologically, type of phantom limb shows conflict between "desire" for the lost limb and "suppression" for giving it up. Thus the type of phantom limb fluctuates according to the circumstance and psychological condition of the amputee; which makes an amputee have different types of phantom limb and makes it "reversible". Psychotherapy facilitates the reversibility. The type of phantom limb as well as the charactor of amputee is stable while psychological, physical and environmental factors keep balance; once they lose balance, both the types and character start to flucturte. If the amputee is left alone he becomes passive and depressed. Remaining under this condition for about a year or more, his character and the type of phantom limb will be fixed.

Type I has two aspects; one shows the strongest "desire" (more so when it has slight phantom pain), the other shows the positive utilization of the phantom limb (often it does not have any phantom pain). Type II is considered to be a modification of Type I. Type II has clinically the greatest utility value and is adapted into any kinds of proshtesis. When the image of phantom limb fits the prosthesis limb and the amputee tries to utilize the phantom limb as the feedback mechaninism positively, it will become so called "incarnated limb". In this case, clinically speaking, it is desirable that the phantom limb appears while wearing the prosthesis and disappears as soon as taking it off. (note: The author witnessed that an amputee soon after amputation woke up in the middle of night to go to the bathroom, tried to bear

Table 1: Development of the Brain (Otsuka)

DIVISION \ AGE	1Y	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1 ANATOMICAL DEVELOPMENT	RAPID DEVELOPMENT			4/5 OF ADULT BRAIN						COMP-LETION						
2 ELECTRO-ENCEPHALOGRAH (E. E. G)		RAPID DEVELOP-MENT				RAPID DEVELOP-MENT									ADULT LIKE WAVE	
3 BRAIN ①CEREBRAL CORTEX (INTENTION. FEELING)					START TO DEVELOP					COMP-LETION						
3 BRAIN ②LIMBIC SYSTEM (INSTINCT, EMOTIONAL BEHAVIOR)			70%		90% OF DEVELOP-MENT					COMP-LETION						
3 BRAIN ③CEREBELLUM					COMP-LETION											
4 LANGUAGE			SPACIAL COGNI-TION		TEMPORAL EXPERIENCE											
			(PARIETAL, OCCIPITAL ASSOCIATION ARBA)			(FRONTAL ASSOCIATION AREA)										
5 PHANTOM LIMB (Otsu ka)	NON-PHANTOM LIMB							START TO HAVE	→ UPPER EXTREMITY FASTER LOWER EXTREMITY LATER						COMP-LETION	
6 EXPERIENCE OF HEAD ACHE			START TO HAVE			40%						60~70%			80%	
7 EYE SIGHT	1.5 YEAR OLD 0.4				ADULT LIKE			(2 MONTH OLD 0.01 3 MONTH OLD 0.05				8 MONTH OLD 0.1				

DEVELOPMENT OF UPPER EXTREMITY

COMPLETION OF UPPER EXTREMITY'S BASIC FONCTIONS (ADL) → LEAD TO { LOCOMOTION, FEEDING, USE OF PROSTHESIS } → BE CONSCIOUS OF HIS Ego.

{ 2 MONTH OLD EMBRYO, STARTS TO ABDUCT THUMB }

N. B 80% OF. A. D. L. CAN BE DONE BY THE USE OF UNI-LATERAL UPPER EXTREMITY

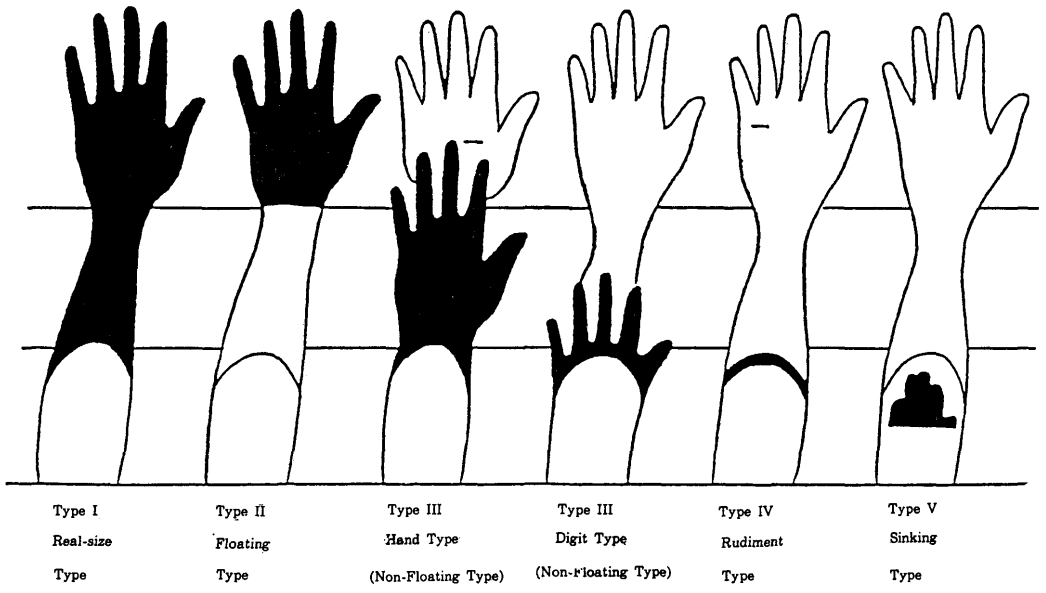

Fig. 1

Table 2: Types of Phantom LImb and Utilities (Otuka)

REVERSIBILITY of PHANTOM LIMB	Desire	Appearance	Types of Phantom Limb	Utility of Phantom Limb		
	strong	Phantom Limb	Type I (Real-size Type)	Available	When Phantom Limb fits the prosthesis and the amputee tries to utilize, it will become "incarntnated limb".	Deformity and abnormal posture before amputation or Phantom Limb with Phantom "Pain" ↓ Vanishment of Phantom Limb ↓ Reformation of adaptive Phantom Limb
			Type II (Floating Type)			
	weak		Type III (Non-Floating Type)	Partially Available	Phantom Limb will be vanished by Psychotherapy and be reformed to be the adaptive Phantom Limb. (Type I or II).	
			i) Hand-Type			
	weak		ii) Digit-Type	Not Available		
			Type IV (Rudiment Type)			
			Type V (Sinking Type)			
	strong	Non-Phantom Limb	Observed at the beginning		Phantom Limb will be reformed to be the adaptive Phantom Limb. (Type I or II).	
			Not observed at the beginning			
	Suppression					

his weight on his phantom limb and fell down)

Phantom limb can shrink, as psychological "suppression" grows stronger, Types I/II change into Type III and finally change into Type V which the phantom limb sinks into the stump. When the "suppression" reaches the greatest state, the phantom limb disappears. An amputee without phatom limb from initial stage is considered to have strong

reservation (except the pediatric amputees). It is possible to let him have a phantom limb. Types III～V show strong psychological "suppression" gradually and phantom limb is "compressed" and "fixed". The author estimates that the impact of "desife" and "suppression" equate each other in Type III. Not a few amputees of Type III show considerable resistance against psychotherapy to wipe out phantom limb. The stumps of them are often not in good condition thus the plastic surgery for the stumps in combination with psychotherapy will lead to successful result. For the plastic surgery evokes the psychological impact which the amputee had at the time of amputation and it works as a kind of hypnotherapy. Upper extrememity amputation of Type III with mobile phantom digits and little phantom pain changes into Type I/II after wearing the prosthesis. This might be caused by the strong desire of the amputee who, without the strong desire, would have utilized phantom limb as the feedback mechanism. Generally, Type III amputee has a phantom limb with contractured fingers in flexion; but in some abnormal cases with severe phantom pain, the contractured fingers are in extention. Theoretically Type IV might be seen in lower extremity amputees, but clinically it has only be seen in upper extremity amputees, which tells the diffrence between upper and lower extremity amputees.

3. Phantom Limbs of Pediatric Amputees

Phantom Limbs are closely related with the development of brain and clinically they can not be seen under six years of age regardless of the stump conditions. It starts to appear around the age of eight and the upper extremity phantom limbs precede the lower extremity ones. Phantom limb with pain appears around the age of fifteen when the body image is fully developed and the patient is out of pediatricians' hand. Here again the phantom limbs are suggested to be related with the central nervous system. And "pain" in pediatric amputees causes little problem.

4. Phantom Limbs of Multi-Extremities Amputees

Phantom limbs of a multi-extremities amputee start appearing at about the same time, and of a bilataral symmetrical amputee are symmetrical and when paied much concern phantom limb and pain are felt strongly. There is a strong tendency that types of phantom limbs of an asymmetrical amputee fall into one type. But the phantom limb is "suppressed" when the amputee is indifferent and the phantom limb falls into Type I or II when the amputee has strong "desire". Disappeared phantom limbs with "suppresion" can be recovered again same as in a mono-extremity amputee. Generally multi-extremities amputees try to utilize phantom limbs as the feedback mechanism positively and scarecely complain of "pain". Clinically speaking, in case of a unilataral above knee and contralataral below knee amputee utilizes the contralateral longer stump as a "dominant foot" with Type I or II which phantom limbs match the size of prosthesis. So does a unilateral above elbow and contralateral below elbow amputee, who utilizes the contralateral longer stump as a "dominant hand".

Generally, the multi-extremities amputee utilizes the longer stump as a "dominant limb" which can also be seen in the projection. This knowlege could be a great help for physical therapy and occupational

therapy. It is possible to fabricate prosthesis out of the projection of phantom limbs when the type of a multi-extremities amputation falls into Type I or II. Clinical experiences tell us that the longitudinal length of a sole approximates the length of ulna and seven times of this length approximates the height of an amputee. Generally, for a bilateral above knee amputee a prosthesis is made 2 to 3 inches short of his height; for a bilateral below knee amputee. 0 to 1 inch short. But when Type I or II phantom limbs are utilized as the feedback mechanism, the prosthesis may be made to the real size of the lost limb.

5. Characteristics of Human being

Main characteristics are the followings:

① bipedal standing and walking (mainly the function of lower extremities and trunk)

② hand function (i. e., the opposition of thumb enables to manipulate objects, sensitivity of receptors as "external brain")

③ "speech" as the supreme mental activity.

These characteristics clearly tell the difference of functions between upper and lower extremities, which is reflected in the central projection; hands occupy greater areas than lower extremities or trunk because the former have larger receptive field than the latters. This difference is also affected in phantom limbs.

6. Relationship between Phantom Limb and Distal Parts

Distal parts which are used frequently in Activities of Daily Living (ADL) are in nervated profoundly. An amputee is conscious of hand (especially radial side) and foot (especially medial side) in ADL but is rather indifferent to other parts. This tells that Type II (Otsuka) phantom limb is sufficient enough for ADL. Brain is said to respond to exteral stimuli thus the parts which are frequently used and/or stimulated (e. g. hand, foot) will produce vivid phantom limbs after amputation. On the other hand, phantom limb of the peripheral chronic disuse disease (e. g. osteoarthro-tuberculosis) will disappear in comparatively early stage and be extinguished easily by psychotherapy. In this case it is considered that the localized body image in the brain is diminished and extinguished gradually according to the decreasing incoming peripheral stimuli.

7. Fluctuation of Phantom Limb and Peripheral Stimuli

The stump can be seen as the mass of regenerating nerve fibers and it will fluctuate between Type I through Type III by equal pressure of the manchette of bemodynamometer. Especially, it becomes senstive to the stimulation when one tries to utilize phantom limb possitively. Contrary, when one is strongly suppressed the phantom limb will scarecely be affected by peripheral stimuli. Here again, the phantom limb is suggested to be of central mechanism supported by peripheral factors. The fact that the phantom limb fluctuates by equal pressure of the manchette of hemodynamometer shows that the fitting condition of the socket and stump relates to the type of phantom limb in clinical situation.

Moreoeer, vertiacl pressure to and move ment of the stump and low frequency stimulation are not considered to cause fluctuatinon of the types. The phantom limb moves along with movement of the stump and the range of motion (ROM) of the phantom limb is equal to or little less than the ROM of the stump.

8. Flexion Posture of Phantom Limb

An amputee of Type I or II can show the positioning of phantom limb with his unaffected limb and some patients can move his phantom limb voluntarily (utilizing phantom limb with the electric prosthesis). But phantom limb has the tendency to take flexion position in general (so an amputee of Type II with finger extention position may have abnormal factors). The abnormality would be caused by following reasons. ① Embryologically human being take flexion posture naturally in embryonic period. This posture requires little muscle contraction. As flexor muscles are stronger than extensor muscles, patients are likely to get a total flexion posture after lying bed for a long period. Human beings develop from "natural posture" with summation of conditioned reflexes to make an independent adults. If an amputee is left without any treatment, he will regress into a "natural" flexion posture like an embryo with the process akin to degeneration of muscular and skelton system. ② Abnormal posture of phantom limb increases pain but "natural" flexion posture of phantom limb decreases phantom pain. Thus an amputee with phantom pain utilizes flexion posture to relieve pain. Sometimes phantom limb holds position at the time of injury. (e. g. An amputee whose upper extremity was twisted behind his back and injuered between a telephone pole and a motor car com complains his phantom limb being just in the same position with pain. If the phantom limb will be put into normal position, the pain decrease. Needless to say, but Type I and Type II amputee can move pha phantom limb voluntarily.)

9. Phantom Limb of Upper Extremity Amputation

The function and sensory mechanism of the hand is very important and thumb and index finger having their own intrinsic muscles carring out most ADL activities. It is estimated that the phantom digits, especially radial side, will linger to the last moment as they occupy wide projection in the brain area. This can also be told by the fact that Type III or V amputee has residual phantom digit and hand. It must be stressed that an upper extremity amputee ia able to do 80% of ADL activities with his unaffected side 92% at most). Prosthesis which is currently used does not meet the function and sensation of a real hand, which affects the types of upper extremity phantom limb. This can be supported by the fact that the majority of upper extremity amputees fall into Type III, I or II which an amputee has strong "desire".

10. Phantom Limb of Lower Extremity Amputation

The function of lower extremity is simpler than that of upper one, and topological projection area in the cerebral cortex is narrow, thus the presense of phantom limb is estimated to be less common in lower extremity amputation. In fact, clinically, Type IV amputation is only seen in upper extremity amputation. Phantom limb of lower extremity has close relationship with gait pattern, which is reflected in the fact that the phantom limb is strongly felt in heel, foot, toe and fingers (espesially medial side). Type I and II phantom limb can be utilized as the feedback mechanism. Lower extremities must take uni-lateral stance when walking, so even a stick-like prosthesis must be worn secure standing and walking in daily life. Clinically

lower extremity prosthesis satisfies essential function more than the upper extremity prosthesis. Type I or II amputee who has phantom limb which is not involved in standing and walking pattern shows malfitting, malalignment of prosthesis and abnormal walking when wearing prosthesis. These can help in checking the fitting of prosthesis.

(To be continued to Part II)

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